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U. S. DEPARTMENT OF AGRICULTURE

Roses for the Home

U. S. DEPARTMENT OF AGRICULTURE • HOME AND GARDEN BULLETIN No. 25

Contents

	Page		Page
Classification of roses	1	Propagation	18
Bush roses	2	Propagation by budding	18
Hybrid teas	2	Propagation by cuttings	21
Floribundas	4	Hardwood or dormant cuttings ..	21
Polyanthas	5	Softwood cuttings	21
Hybrid perpetuals	6	Propagation from seed	21
Shrub roses	6	Diseases of roses	24
Old-fashioned roses	6	Black spot	25
Tree or standard roses	6	Powdery mildew	26
Miniature roses	7	Rust	27
Climbing roses	7	Canker diseases	28
Ramblers	7	Crown gall	28
Large-flowered climbers	7	Virus diseases	29
Everblooming climbers	7	Insects attacking roses	30
Climbing hybrid teas	9	Insecticides are poisons	31
Climbing polyanthas and		Japanese beetles	31
floribundas	9	Rose chafer	33
Trailing roses	9	Rose leaf beetle	33
Culture of roses	9	Rose slugs	33
Locating the planting	9	Rose leafhopper	33
Soils and their preparation	10	Thrips	33
Time to plant	10	Aphids	33
Spacing of plants	10	Rose scale	35
How to plant	11	Rose midge	35
Watering	12	Leaf-cutter bees	35
Cultivating and mulching	13	Spider mites	35
Fertilizing	13	Rose stem borers	36
Disbudding	15	Rose galls	37
Cutting the flowers	15	General recommendations for disease	
Pruning	15	and insect control	37
Winter protection	16		

COVER ILLUSTRATION—Peace rose

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Roses for the Home

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ROSES are probably the most popular of all garden flowers. They are adapted to many purposes and are grown in every section of the country.

Varieties are available for plantings on lawns and borders, for arbors, trellises, bedding, hedges, ground covers, as specimen tree roses, and for cut flowers. They are grown not only in areas where the climate is especially favorable, but also in areas where success can only be attained with extra care.

Some wild species of roses are very desirable and may be found in many gardens. They are gradually being replaced, however, by named

varieties that are developed by plant breeders. Newly developed varieties are offered each year in garden catalogs in a wide range of colors and forms. A difficult problem for the beginner is choosing from among the many kinds of roses he finds available.

Through research, new methods have been developed for controlling diseases and insects. Research has also resulted in improved cultural practices with respect to pruning, fertilizing, and the best method of cutting blooms. These new disease- and insect-control measures and improved cultural practices are discussed in this bulletin.

Classification of Roses

Roses are generally classified into groups according to similarity in habit of growth, form of flower, hardiness, and other characteristics. Actually, however, there is no sharp line of difference between all of the various types, because plant breeders have crossed and recrossed varieties from different sections until many modern roses now possess characters from two or more groups. Nevertheless, the roses now generally recognized as belonging to one group

have many characteristics in common and also respond to the same general cultural practices. Practically all rose catalogs now list rose varieties under these recognized groups. The gardener needs an understanding of the differences between groups so he can select precisely the varieties he wishes to grow.

There are two main classes of roses—bush roses and climbing roses. These two classes are based

entirely on habit of growth. Bush roses grow from 1 to 6 feet in height and require no support. Climbing roses produce long canes each year and must be provided with some type of support.

Bush Roses

Bush roses include many types grouped according to flowering habit, winter hardiness, and other traits. These types are hybrid teas, floribundas, polyanthas, hybrid perpetuals, shrubs, old-fashioned, tree or standard, and miniature.

Hybrid Teas

Hybrid teas are more widely grown and more popular than all other types of roses combined. They are the so-called monthly or ever-blooming roses, and are the ones grown in beds in rose gardens and by florists under glass. In fact, when the word "rose" is used, it generally suggests a hybrid tea variety.

The plants grow from about 2 to 6 feet or more, depending on the culture, type of pruning, and climatic conditions. The flowers vary from singles that have but one row of petals to doubles with many rows. In general, the buds are pointed and long, and the flowers are borne one to a stem or in clusters of three to five. Hybrid tea varieties exist in a wide range of colors, including pure white, and many shades of red, yellow, pink, and orange. All varieties are good for cutting, although some have rather short stems.

Most hybrid teas have some fragrance. This characteristic, however, is variable; some varieties are very fragrant and others only slightly fragrant. When fragrance is present it is usually more intense in the early morning before the fragrant oil has evaporated from the base of the petals.

Most hybrid teas are winter-hardy in the milder sections of the country, but varieties differ in cold resistance. In sections where winters are severe, practically all varieties need some protection.

The American Rose Society issues a list annually of the most popular hybrid tea varieties. They are grouped by color, and rated according to the following point system: (1) 7 to 7.9—a very good rose; (2) 8 to 8.9—an excellent rose; (3) 9 to 10—a finer variety; and (4) 10—a perfect rose. A recent list included the following varieties:

Red

	Points
Crimson Glory	9.5
Charlotte Armstrong (fig. 1)	9.0
Etoile de Hollande	8.9
Christopher Stone	8.8
Poinsettia	8.4
Grande Duchesse Charlotte	8.3
Nocturne	8.3
Tallyho (fig. 2)	8.3
New Yorker	8.2
Red Radiance	8.0
McGredy's Scarlet	7.9
Texas Centennial	7.9
Rubaiyat	7.8
Applause	7.8
Volcano	7.8
Margaret McGredy	7.7
Rose of Freedom	7.7
Anne Vanderbilt	7.6
Red Duchess	7.6

Pink

Dainty Bess	8.7
Picture	8.4
Curly Pink	8.2
Lulu	8.2
Radiance	8.2
Show Girl	8.2
Pink Princess	8.1
Mrs. Charles Bell	8.0
First Love	8.0
Betty Uprichard	7.9
The Doctor	7.9
Editor McFarland	7.7
Symphonie	7.7
Katherine T. Marshall	7.6
Pink Satin	7.6
Santa Anita	7.6

Yellow

Eclipse	8.5
Golden Dawn	8.1
Debonair	7.9
McGredy's Yellow	7.9



Figure 1.—Charlotte Armstrong, a red-flowered hybrid tea.

	<i>Points</i>		<i>Points</i>
Soeur Thérèse	7.9	San Gabriel	8.1
V for Victory	7.9	Saturnia	8.1
Golden Scepter	7.5	Sutter's Gold	8.1
WHITE		Comtesse Vandal	8.0
Pedrálbes	8.0	Mme. Cochet-Cochet	8.0
McGredy's Ivory	7.8	Condesa de Sástago	7.9
White Wings	7.7	Duquesa de Peñaranda	7.9
Snowbird	7.6	Mission Bells	7.9
Mme. Jules Bouché	7.3	Sonata	7.9
Neige Parfum	7.0	Mme. Joseph Perraud	7.8
BLENDS		Signora	7.8
Peace	9.4	Angels Mateu	7.7
Mme. Henri Guillot	8.9	McGredy's Sunset	7.7
Good News	8.4	Paramount	7.7
Mrs. Sam McGredy	8.3	Sierra Glow	7.7
President Herbert Hoover	8.2	California	7.5
		Edith Nellie Perkins	7.5
		Hill Top	7.5

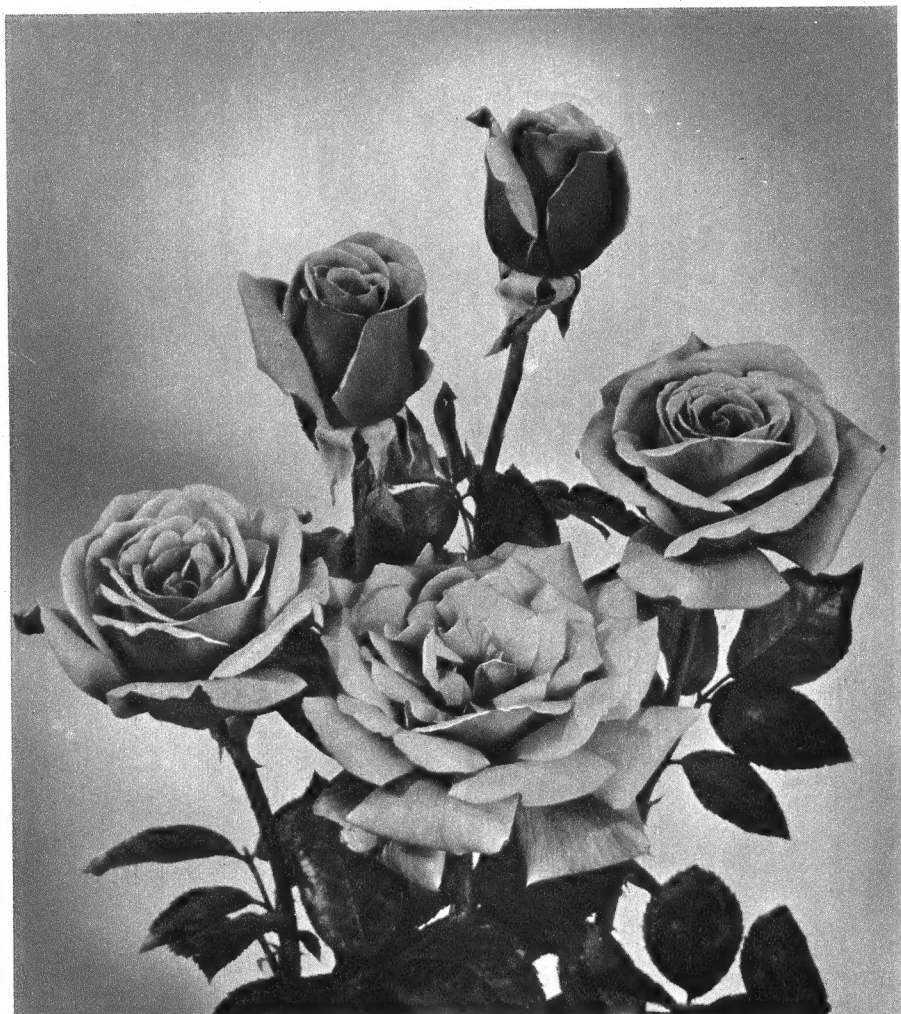


Figure 2.—Tallyho, a red-flowered hybrid tea.

Floribundas

Floribunda roses bear their flowers in clusters, and the individual blooms of many closely resemble hybrid teas. They are increasing in popularity, especially for bed plantings where large numbers of flowers are wanted. As a rule floribunda varieties are hardy—they will tolerate more neglect than any other type of rose with the possible exception of some of the shrub species. While some are fine for cutting, they will not replace hybrid teas for this purpose.

The following floribunda varieties and relative ratings of excellence were included in a recent list of the American Rose Society:

RED

Donald Prior	8.6
Red Pinocchio	8.4
Frensham	8.3
Alain	8.2
Floradora	8.2
World's Fair (fig. 3)	8.2
Permanent Wave	8.1
Crimson Rosette	7.9
Glorious	7.9

PINK

Rosenelfe	8.9
Betty Prior	8.8



Figure 3.—World's Fair, a red-flowered floribunda.

Else Poulsen	8.7
Fashion	8.6
Nearly Wild	8.2
Pinkie	7.9
Pink Bountiful	7.9
Cecile Brunner	7.7
Pinocchio	7.6

YELLOW

Goldilocks	7.9
King Boreas	7.4

WHITE

Summer Snow	8.4
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Dagmar Späth	8.2
Irene of Denmark	8.0

Polyanthas

Polyantha roses are distinguished from the floribundas by their smaller flowers, which are borne in large clusters. They are closely related to many of the climbing roses, having flower clusters very similar to them in form and size of indi-

vidual florets. The polyanthas are hardy and may be grown in many sections where hybrid teas are difficult to grow. Their chief use is in bed plantings or in borders with other perennials. They are excellent for mass plantings.

Some of the better varieties are:

Cameo	Light salmon
Carol Ann	Orange pink
Cécile Brunner	Light pink
George Elger	Yellow
Gloria Mundi	Orange scarlet
Miss Edith Cavell	Scarlet
The Fairy	Pink

Hybrid Perpetuals

Hybrid perpetuals are the June roses of grandmother's garden. Their flowers are large. Generally they lack the refinement of hybrid teas: an exception is the white-flowered variety Frau Karl Druschki, which many consider the finest white rose in existence.

Prior to the development of modern hybrid teas, hybrid perpetual roses were very popular. As their name indicates, they are considered as ever-blooming types, although most of them do not bear continuously through the growing season as do hybrid teas. They usually develop large, vigorous bushes if given good cultural care and proper pruning. They are very hardy and stand low winter temperatures without protection.

Some of the better varieties are:

Général Jacqueminot	Red to crimson
Ulrich Brunner	Red to crimson
Henry Nevard	Red to crimson
Magna Charta	Red to crimson
Baroness Rothschild ...	Pink
Mrs. John Laing	Pink
Paul Neyron	Pink
Frau Karl Druschki	White

Shrub Roses

Shrub roses are actually a miscellaneous group of wild species, hybrids, and varieties that develop an open-bush type of growth that is useful in general landscape work. They are hardy in all sections of the country. While their flowers do not

equal in size or form those of other types of roses, many bear very attractive seed pods in the fall. They have very fine foliage and some are quite useful for hedges or screen plantings.

The following list includes the most popular varieties:

<i>Rosa hugonis</i>	Yellow
<i>Rosa moyesii</i>	Blood red
<i>Rosa pomifera</i>	Pink
<i>Rosa rubrifolia</i>	Pink
<i>Rosa setigera</i>	Pink
Dr. Eckener	Coppery rose
F. J. Grootendorst	Red
Gruss an Teplitz	Red
Harison's Yellow	Deep yellow
Nevada	White
Pink Grootendorst	Pink
Sarah Van Fleet	Pink

Old-Fashioned Roses

Old-fashioned roses include the varieties and species that were popular in Colonial gardens. Usually they are very fragrant, and in this respect surpass our modern varieties. They lack, however, the finished form and grace of flowers of present-day varieties. These roses are all very hardy, require little care, and furnish an abundance of flowers in June.

Among the varieties occasionally found in gardens are:

<i>Rosa centifolia</i> (cabbage rose) .	Light pink
Moss Roses	Pink
Cardinal de Richelieu	Purplish red
<i>Rosa mundi</i>	Striped white and red
York and Lan- caster	Pink and white and variegated

Tree or Standard Roses

This class refers to the form of the plant rather than to the type of flower. Any bush type of rose may be made into a tree form, and many of the better known varieties are now available as tree roses. Such specimen types of plants are used in rather formal arrangements or to accent a particular portion of the garden. The plants are subject to winter injury. In sections where

the winters are severe they need special protection.

Miniature Roses

The miniature roses have become popular only in the last few years. The plants, including leaves and flowers, are very small. Some varieties never grow much over 6 inches high, while others may reach 12 to 15 inches. They are used mostly for rock gardens and edging beds and borders. New varieties are appearing every year. Among the better varieties are the following:

Baby Gold Star	Yellow
Midget	Red
Oakington Ruby	Red
Pixie	Pale pink
<i>Rosa rouletti</i>	Pink
Sweet Fairy	Pink
Tom Thumb	Red
Pompon de Paris	Pink
Bo-Peep	Rose pink

Climbing Roses

Climbing roses include all varieties that produce long cane growth and require some sort of support to hold the plants up off the ground. They are often trained on fences or trellises, and some are used to cover banks and aid in holding the soil in place. Climbing roses are rather hardy. They are becoming more popular with the development of finer varieties.

Climbing roses, like bush roses, are grouped into several classes. There is much overlapping among classes, and some varieties could qualify under several. The following classes are now generally used in most catalogs: Ramblers, large-flowered climbers, ever-blooming climbers, climbing hybrid teas, climbing polyanthas, climbing floribundas, and trailing roses.

Ramblers

Rambler roses are very rapid growers. They sometimes develop canes as long as 20 feet in one season. The flowers are small, less than 2 inches across, and are borne in dense clusters. The plants flower

only once during a season and on wood that was produced the preceding year. The foliage is glossy and the plants are very hardy, but, unfortunately, many varieties are very susceptible to mildew. Rambler roses are not nearly so popular as they were a few years ago. They are being replaced by other climbing types that bear larger flowers and are less subject to mildew.

Some of the better varieties are:

Crimson Rambler ...	Crimson
Excelsa	Red
Hiawatha	Red with white eye
Dorothy Perkins	Pink
White Dorothy	White
Chevy Chase	Crimson
Evangeline	Rosy-white

Large-Flowered Climbers

Large-flowered climbers grow rather slowly in comparison with ramblers. They are often trained on posts or some other type of small support, and may require rather heavy annual pruning to keep them in bounds. These roses are well adapted to small gardens where they may be trained against a wall, fence, or small trellis. When the plants are grown well, the flowers are rather large and useful for cutting. Many varieties do not bloom so freely when the canes are trained vertically rather than horizontally.

From among the varieties available the following are recommended:

Bess Lovett	Red
Dr. Huey	Red-maroon
Paul's Scarlet Climber	Red
Dr. W. Van Fleet ...	Pink
Mary Wallace	Pink
City of York	White
Mary Lovett	White
Silver Moon	White
Doubloons	Yellow
Gardenia	Yellow
Glenn Dale	Yellow
Jarotte	Salmon and apricot

Everblooming Climbers

The everblooming climbers are not so strong growing or continuous in blooming as the hybrid teas. They produce an abundance of flowers in the early summer. This



Figure 4.—High Noon, a yellow-flowered climbing hybrid tea.

is followed with a few scattered blooms until fall when, if growing conditions are good, they may again bear rather heavily. Plant breeders are improving this class of rose rather rapidly. Eventually, climbers will be available that will be as continuous in blooming as hybrid teas and will also be more winter hardy.

Of the varieties available, the following are very satisfactory:

Blaze	Red
Flash	Red
Dr. J. H. Nicolas	Pink
New Dawn	Pink
Mermaid	Yellow and orange
Mrs. Whitman Cross.	Yellow and orange
Penelope	White
Prosperity	White

Climbing Hybrid Teas

Climbing hybrid tea roses have originated as seedlings and as chance sports of bush varieties. When a bush hybrid tea produces a cane that has the climbing character, the new type of plant is usually given the same name as the bush variety from which it originated, as, for instance, Climbing Crimson Glory. The climbing forms of hybrid teas, in general, do not have so pronounced a continuous blooming habit as their bush parents. The flowers, foliage, and other characters, however, are usually identical. The climbing hybrid teas are just as susceptible to winter injury as the bush forms, and require good winter protection in northern areas.

Among the best climbing hybrid

tea varieties available are the following:

Climbing Crimson Glory	Red
Climbing Christopher Stone	Red
Climbing Golden Dawn	Yellow
Climbing Mrs. Sam McGredy	Blend
Climbing Talisman	Pink
High Noon (fig. 4)	Yellow
Sungold	Yellow

Climbing Polyanthas and Floribundas

These types, like the climbing hybrid teas, have originated as sports and seedlings from polyanthas and floribundas. Their flowers are generally identical with the bush forms from which they originated, and they also are fairly continuous in blooming. They are hardier than the climbing hybrid teas, but not hardy enough to be grown in severe winter climates unless provided with winter protection.

Some of the better varieties are:

Climbing Goldilocks	Yellow
Climbing Pinocchio	Pink blend
Climbing Pinkie	Pink

Trailing Roses

Trailing roses are simply climbers that are adapted to planting on banks or walls. They produce long canes that creep along the ground, making a pleasing ground cover. Their flowers are not so attractive as other types, but they are hardy and have a place in some gardens.

Some of the better varieties are:

Carpet of Gold	Double yellow
Coral Creeper	Apricot and pink
Little Compton Creeper	Deep pink
Rosa wichuraiana	White
Max Graf	Pink

Locating the Planting

Roses attain their best growth in full sunshine, but good results may be obtained if they are exposed to sunshine for at least 6 to 8 hours a day. If it is impossible to avoid shade, it is far better to have it on the plants in the late afternoon.

If the plants are in morning shade, the foliage will remain wet with dew for a few hours longer than if in direct sunlight, and the presence of moisture on the leaves is a very favorable condition for the development of several leaf diseases.

Good soil drainage is also impor-

tant in the successful growing of roses. Poorly drained soils, or any location where water accumulates after every rain, will not produce good roses. Good drainage can be provided by installing tile about 18 to 20 inches below the soil surface. If a large area is involved, the tile should be spaced 6 to 10 feet apart, depending on how poor the drainage is. The tile should be sloped about 3 inches for every 10 feet, and some provision should be made to drain off the water carried by the tile.

Soils and Their Preparation

Any good garden soil will produce good roses. If good grass, shrubs, and other plants will grow in the garden, it is practically certain that no special treatment of the soil is necessary for roses. When, however, the soil is known to be very poor, as is the case when the subsoil from a basement excavation has been used to level off a building lot, special soil preparation is necessary. Either heavy soil or a sandy soil lacking fertility can be greatly improved by the addition of organic matter. Organic matter includes any decaying plant or animal refuse, such as peat, leafmold, or well-rotted manure. In some instances it may be advisable to remove a layer of soil 12 to 18 inches deep and mix it thoroughly with well-rotted manure in the proportion of about 6 bushels of soil to 1 of manure. Peat or leafmold, if used, should be mixed in the proportion of 1 part peat or leafmold to 4 parts of soil. It is also usually advisable to mix thoroughly with the 7-bushel mixture of soil and manure about $\frac{1}{2}$ pound of superphosphate.

Soils that do not require such extensive treatment as outlined can be greatly improved by spreading organic matter evenly over the soil surface and working it in to about

the depth of a spade length. The amount to apply will vary with the condition of the soil, but 2 to 4 inches of peat, leafmold, or well-rotted manure will be beneficial.

Time to Plant

There is considerable disagreement among rose growers as to whether spring planting or fall planting is the most satisfactory. Actually, it is impossible to state arbitrarily that any particular time of planting is best. First, what is best for one section may be undesirable for another. Secondly, what may happen in one season, from a weather standpoint, may not occur the next. The beginner who is in doubt as to the best time to plant in his section should obtain the advice of local rose growers.

In general, fall planting, or later, is believed best in areas where the winters are relatively mild. In very cold sections, the temperature usually drops too early in the fall for newly planted roses to become established before severe freezing. Under such conditions spring planting is necessary. In sections where the winters are mild, roses may be planted at any time when they are fully dormant.

Spacing of Plants

The spacing of rose plants depends on several factors, including the variety of the rose, the climate in which it is grown, the method of pruning to be used, and the type of bush desired. There is considerable difference in vigor among the varieties. A strong grower, such as Crimson Glory, may require twice as much space as many others. It is now believed that hybrid tea roses should be spaced at least 2 feet or more in sections where winterkilling of the canes is not severe and it is possible to grow rather large bushes.

Where the climate is so severe that the plants are usually killed back to a few inches above the soil, it is advisable to plant somewhat closer. In any case, enough space should be allowed so the plants can develop fully and receive as much sunlight and aeration as possible. Such spacing provides room for good culture, and for spraying or dusting operations to control diseases and insects. Plants that have ample room also produce more and better flowers, and it is more economical to plant a bed properly with 25 plants than to crowd in 35 or 40. Generally, hybrid teas, polyanthas, and floribundas should be planted about 2 feet apart in areas where the winters are very cold, about 2½ feet apart in sections with mild winters, and at least 3 feet apart in the Southern and Pacific Coast States. Hybrid perpetuals should be spaced 3 to 5 feet and climbers from 8 to 10 feet apart.

How to Plant

When a rose garden is to be established, or when only a few plants are added to the planting, the soil should be prepared in advance and the spot where each plant is to be placed located with a stake. If the soil needs to be completely reworked, this should be done in the fall—for either spring or fall plantings. For fall plantings, the soil should be reworked 4 to 6 weeks before the plants are set out.

Rose plants should be set out as soon as they are received. If this is not possible the plants should be unpacked and examined to see if the roots have dried out. If the sphagnum or other packing material about the roots is dry, it should be moistened and replaced, provided planting is not delayed more than a few days. If it is necessary to delay planting longer than a few days, the plants should

be unpacked and heeled in, that is, placed in a trench and the roots covered with moist soil. If the roots are dry when received, they should be soaked in water for several hours before heeling them in. If the stems are also dry the condition of the plants may sometimes be improved by burying them for a few days in moist soil. If plants are received in a frozen condition, they should be stored where they will thaw out gradually and not unpacked until completely free from frost.

When all preparations for planting have been made, the roots of each plant should be carefully examined. All dead or injured growth should be cut off. The top should also be pruned if needed (fig. 5). Generally nurseries cut back the tops of roses to about 12 inches before shipping them. Any dead or injured wood should be removed. If stems are cut back to less than 10 inches, flowering is usually delayed.

When the plants are ready to be set out, take them to the garden with their roots covered. The roots should never be exposed to the sun or drying winds. Failure to protect the roots at this time may result in very poor growth of the plants or even death. Plants should be moved to the planting ground in a bucket with their roots covered with water or puddled in a thin mixture of clay mud, and then kept covered with wet burlap or some other protection until planted.

Prepare all the planting holes at the same time and to the same depth. This insures regular spacing and a uniform planting. The holes should be made about 12 inches deep and at least 18 inches in diameter. Completely loosen the soil at the bottom of each hole, and, if the soil is very poor, about a half spadeful of well-rotted manure may

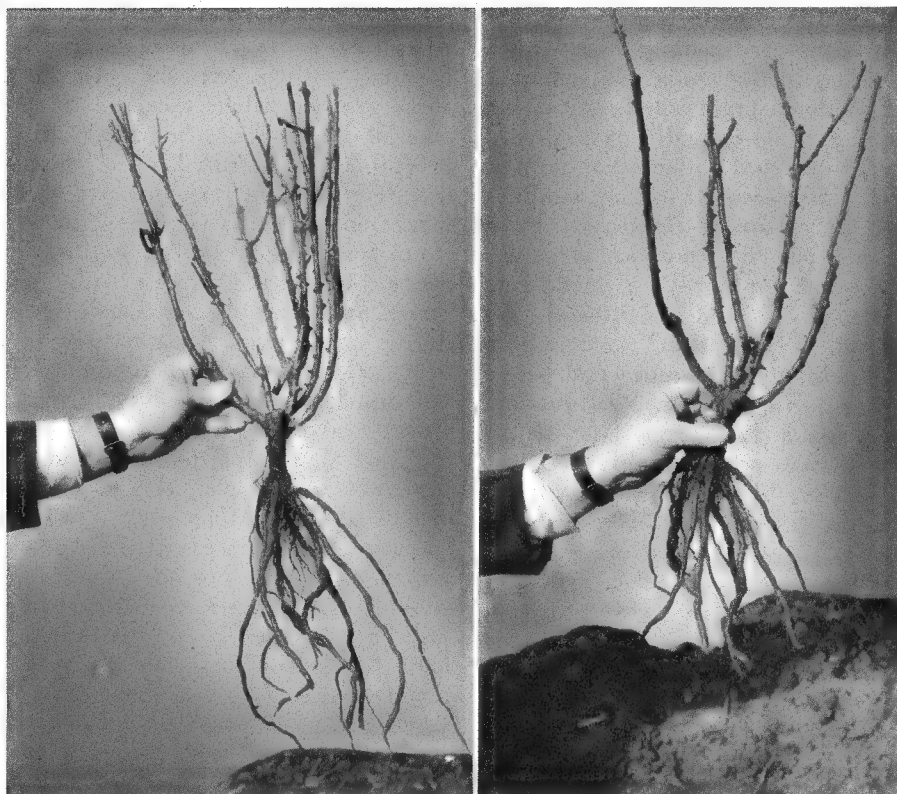


Figure 5.—Left, hybrid tea rose bush as received from nursery; right, same bush after top and roots have been pruned.

be worked in at this time. Fresh manure must be used with caution, since it may injure any roots coming in contact with it. A small cone-shaped pile of soil at the center of the planting hole, as shown in figure 6, is helpful in placing the roots and setting the plant at the proper depth.

Depth of planting will depend on the severity of the winters to which the plants will be exposed. In very cold areas the plants should be set with their bud union about 2 inches below the soil level; in moderately cold climates, 1 inch is considered enough, and in warm areas the union should be at soil level or just below it. The soil should be carefully worked about the roots so that all roots are in close contact with the soil and all air pockets are

eliminated. When the roots are covered it is advisable to add water which will help to settle the soil about the roots. Then the hole may be filled. A slight depression left around each plant will serve as a catch basin for rain, and also facilitate watering until the plants are well established.

Watering

Roses require large amounts of water. Even in areas where rainfall is considered plentiful, occasional waterings will usually be beneficial. In sections where the growing season is dry or subject to periodic droughts, a regular irrigation program is necessary to obtain good roses. The best method of applying water is in a small stream from a hose. The slow moving water will

seep into the soil and wet it down thoroughly. A heavy stream of water is usually wasteful and ineffective; most of the water runs off and it fails to penetrate the soil more than a few inches. To be effective the water should penetrate the soil from 8 to 12 inches.

Cultivating and Mulching

The roots of roses may grow rather close to the soil surface. Therefore, cultivation must be done with care. The main purpose of cultivation is to remove weeds, and this can be done by hand pulling or cutting them at the soil surface. Weeds compete with the roses for nutrients as well as moisture.

Many gardeners now use rather heavy mulches on their rose beds as an aid in controlling weeds, conserving moisture, and adding fertility. Mulches of many materials have been used successfully on roses, including peat, ground corncobs, ground tobacco stems, buckwheat and cottonseed hulls, spent mushroom manure, and well-rotted strawy manure. The mulches are usually applied about a month before the roses bloom. They are spread evenly around the plants to a depth of 2 or 3 inches. All weeds should be removed and the soil raked lightly before the mulch is spread. The decaying mulching material becomes incorporated into the soil. Many gardeners keep on a mulch throughout the year, adding new material as the mulch settles and becomes thin about the plants.

Fertilizing

Roses are more often overfed than underfed. The average gardener, wishing to obtain the finest flowers, often believes he can accomplish his objective by heavy applications of fertilizers. A judicious use of fertilizers will aid in producing

superior blooms, but fertilizers will not replace good general care, including proper watering and spraying for insect and disease control.

Roses prefer a slightly acid soil. The acidity or alkalinity of a soil is expressed in terms of pH values. A soil that is neutral, that is, neither acid nor alkaline, has a pH of 7. Values below 7 indicate the soil is acid and values above 7 indicate it is alkaline. Soil tests for acidity or alkalinity usually can be obtained from county agricultural agents or State experiment stations. In general, roses grow best when the pH of the soil is from 5.5 to 6.5 (slightly acid). If the pH of the soil is lower it may be raised by adding agricultural lime at the rate of about 3 to 4 pounds per 100 square feet. If the pH is over 6.5, the soil may be made acid by applying powdered sulfur at the rate of 1 to 3 pounds per 100 square feet, depending on how high the pH of the soil is. As a rule 1 pound of

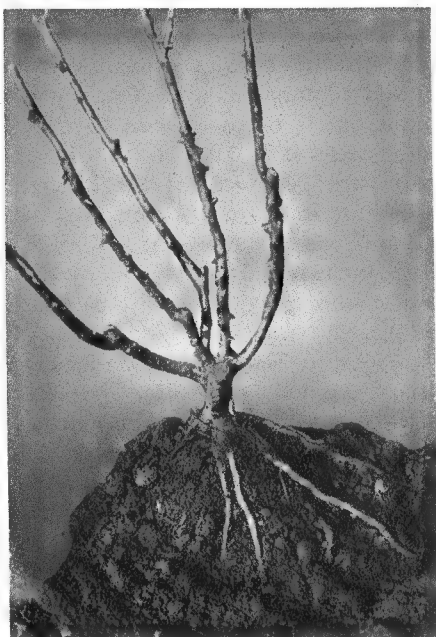


Figure 6.—Rose bush placed in planting hole with roots spread out over a cone of soil.

sulfur per 100 square feet is enough when the pH is 7 to 7.5. If the pH is 8, about 2 pounds of sulfur will be required, and for a reading of pH 8.5, about 3 pounds of sulfur should be applied. Since the pH value of a soil can change rather quickly, it is advisable to recheck at monthly intervals after treating to see if another application of lime or sulfur is needed.

Good roses can be grown with little additional fertilization in a good fertile garden soil with a satisfactory pH value. If the soil is poor the plants will soon show symptoms indicating a deficiency for one or more of the required fertilizer elements. Generally, most soils have ample quantities of all the necessary fertilizer elements except nitrogen, phosphorus, potassium, and sometimes calcium and iron. When the soil is deficient in nitrogen, the leaves, especially the younger ones, become yellow and are smaller than those on plants receiving ample quantities of nitrogen. When phosphorus is lacking the leaves become grayish green, and a purplish tinge often appears on the underside. A deficiency of potassium is more difficult to diagnose because it may be confused with spray injury. Plants lacking potassium soon show a browning on the margins of the leaves, and sometimes a brown area appears on the flower stem just below the base of the flower.

Calcium deficiency causes the margin of the leaflets to die. Eventually the entire leaf dies and drops off. The flowers may be deformed with brown spots near the margins of the petals. When these symptoms appear a soil test should be run. If the pH value is below 5, lime should be added to build up the calcium supply.

Iron is necessary for the formation of the green color in leaves.

When iron is lacking the leaves may become yellowish and the veins may stand out rather prominently.

Probably the best source of the elements needed by roses for growth, except calcium and iron, is the so-called complete or mixed fertilizers. They are sold in a wide range of mixtures, such as 5-10-5, 4-8-4, or 4-8-6. The figures in each case indicate the percentage of nitrogen, phosphorus, and potassium, respectively, in the fertilizer. Thus a 5-10-5 fertilizer is one that contains 5 pounds of nitrogen, 10 pounds of phosphorus, and 5 pounds of potassium in every 100 pounds of mixture. As a rule most soils are well supplied with iron. In some sections of the country, however, as on the Great Plains area, iron may be deficient, causing the rose foliage to turn yellowish white. This condition is known as iron chlorosis and is corrected by spraying the foliage with ferrous sulfate. This is used at the rate of 1 ounce of ferrous sulfate to 2 gallons of water.

When a complete fertilizer is used it is advisable to apply it several times during the growing season. The first application should be made when the new spring growth is well established and all danger of severe freezing is past. If the plants show signs of deficiency later on, a second application may be made. Fertilizers should not be used in cold climates after July 15, and in mild climates after August 15. When used too late in the season they may stimulate fresh growth and delay hardening of the wood before winter sets in. In general, complete fertilizers are used at the rate of about 3 pounds per 100 square feet or a heaping tablespoonful for each plant. Spread the fertilizer evenly and scratch it into the soil, preferably just before a rain or prior to watering the rose bed.

Disbudding

If large exhibition or single-stem roses are wanted, it is necessary to remove some of the flower buds. This is called disbudding. It should be done when the flower buds are very small. The terminal bud is usually selected and all other buds are removed. The terminal bud then develops into a much larger flower. The flower clusters of polyanthas, and any roses bearing many flowers per stem, will be improved by partial disbudding.

Cutting the Flowers

Cutting rose flowers is in itself an important cultural operation. Use sharp tools. Breaking or twisting off the flowers injures the remaining wood. The leaves of all plants are the factories in which the energy of the sun is used to manufacture food material used by the plant to produce more stems and leaves. Many gardeners cut blooms with stems so long they rob the plant of too much of its manufacturing capacity, and thus cut down the growth and subsequent flower yield of their plants.

During the first season of bloom the flowers should be cut with very short stems only. In fact some gardeners do not cut any flowers during the first season of bloom. If the early flowers are not cut the plants will usually develop into large bushes by fall and some flowers may be cut then. Even when the plants are well established it is unwise to cut stems any longer than actually needed. Leave at least two leaves between the cut and the main stem.

Hybrid tea roses usually have three leaflets at the top of the rose stem, and below that a spray of five leaflets. Make the cut just above the topmost spray of five leaflets if the stem is weak. If the stem is as thick as a pencil, the cut may be

made above a higher three-leaflet spray.

If the flowers are not cut they should be removed when the petals fall. Cut them with a sharp shears or knife above the topmost leaf. A withered individual flower in a cluster should be removed to give the remaining flowers more room to develop. After all the flowers of a cluster have withered, the entire stem should be cut off just above the top leaf.

Roses that are cut just before the petals start to unfold will continue to develop normally and remain in good condition longer than if they are cut after they are fully open on the plant. Roses will also keep better when cut in the late afternoon.

Flowers that start to wilt prematurely indoors can be revived and their usefulness extended for several days. Make a slanting cut an inch or so up from the base of the stem, and place the stems in very hot water for a few minutes. Boiling water removed from the stove for a few minutes is satisfactory. Then plunge the stems quickly into cold water. The hot water drives off any air bubbles that may have formed in the water-conducting tissues of the stems and permits the cold water to rise and revive the flower. This treatment will not revive old flowers that have reached the full extent of their usefulness, or flowers that have been wilted for several hours.

Pruning

The pruning of roses, for some reason, is believed to be a very difficult operation and one upon which success or failure with roses depends. Actually it is a rather simple procedure. Sharp tools should be used to give clean cuts. A fine-toothed saw is useful on heavy canes, but do not injure the

bark. The main purposes of pruning are to improve the appearance of the plants, to remove dead wood, and to control the quantity and quality of flowers produced. If roses are not pruned, they soon grow into a bramble patch and the flowers are small and of poor quality. Sometimes undesired shoots come from the understock. These should be removed as soon as they appear. Figure 7 shows a rose bush before and after pruning. This bush had not been pruned for several years.

The type of pruning to use and the time it should be done differs with the various classes of roses. Bush roses are pruned in early spring just before growth starts. First the dead wood should be removed; be careful to cut an inch or so below the dark-colored areas. If no buds are left on the live wood, the entire branch or cane should be removed. Next, cut out all weak growth, and any canes or branches growing toward the center of the plant. If two branches cross one another, remove the weaker. Do not leave any stubs, but make the cut close to the cane or point from which it originated. Finally, shape the plant by cutting the strong canes to a uniform height, but leave as much good wood as possible. Cuts made on the cane should be just above a strong outward-facing bud. In mild climates strong plants can be pruned to a height of 24 to 30 inches.

In some sections the winters are so severe that much of the top of the plant is killed. Under these conditions it is not possible to do much toward shaping the plants. If possible, save all live wood, and be sure to make all cuts just above outward facing buds.

Tree roses usually require rather severe pruning; otherwise the tops will become too large for the stem. After removing all dead wood, cut

back the live canes to 8 to 12 inches and shape the over-all structure. Some pruning will be necessary during the flowering season, or the head will grow out of bounds.

The hardy rambler climbing roses should be pruned just after they have flowered. This will stimulate new cane growth and the development of laterals on which the next year's flowers will be borne. Remove all old wood at this time so the plant can put all its efforts into the development of the new young shoots. Where the roses are trained over a trellis or any support so high that one season's growth will not cover it, some of the older shoots should be cut off at the ground, but the newer ones should be allowed to remain. Strong, vigorous canes should be shortened, so that laterals will develop and continue to elongate and eventually cover the supporting structure.

In the spring remove all dead canes and weak branches, but prune sparingly because wood removed at this time will reduce the number of flowers produced later.

Many of the large-flowered climbers, and especially the everblooming types, do not produce as much growth each year as the hardier climbers. For this reason pruning must be less severe than on the ramblers and hardier climbers.

Most of the shrub roses should also be pruned after the blooming season. As a rule these plants are very hardy, so pruning is needed primarily to thin out and remove old canes. In all instances this type of rose is most pleasing when allowed to develop its natural shape.

Winter Protection

The amount of cold a rose plant will withstand depends on its natural hardiness, the condition of the plant when it became dormant, and

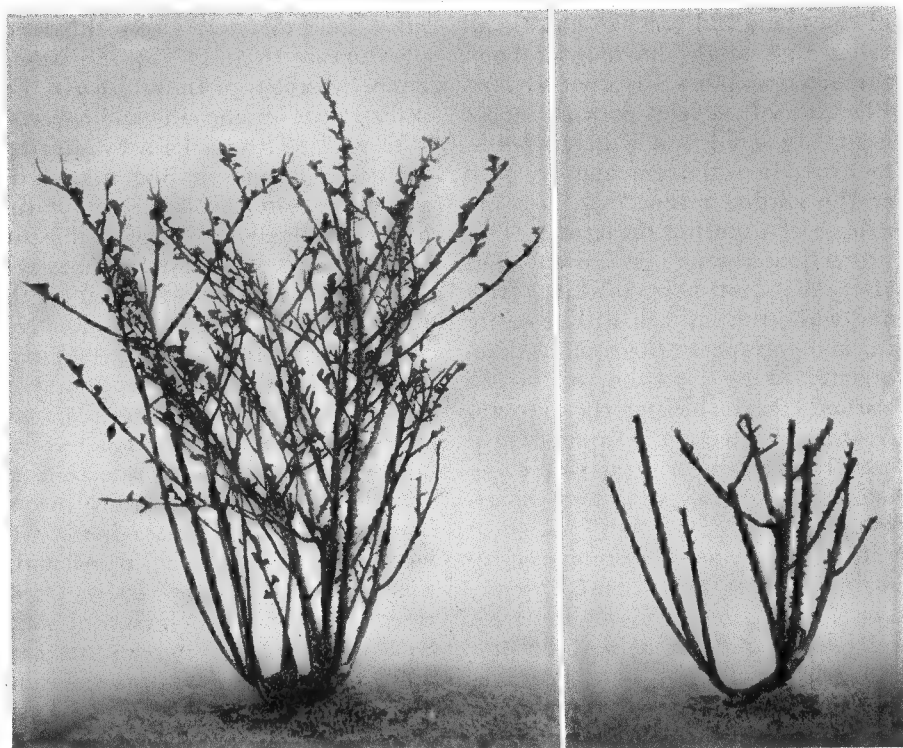


Figure 7.—Left, hybrid tea rose bush that had been allowed to grow several years without pruning; right, same bush after being pruned.

the manner in which the low temperature occurs. The hardiness of the various classes of roses is discussed under Classification of Roses, page 1.

There is now some evidence that when roses have been protected against black spot and other diseases, and thus pass through the growing season with their leaves in a vigorous, healthy condition, they are more likely to escape severe winter injury, since healthy plants are able to manufacture the maximum amount of sugars and to mature normally. When roses lose their leaves from disease or mineral deficiencies, new growth is usually stimulated late in the growing season. When this happens, the plants produce more leaves and go into the winter in an immature condition. They will, therefore, be more susceptible to cold injury than fully

matured plants. One method of warding off winterkilling therefore is to keep the plants healthy and growing normally during the summer.

Occasionally we hear of some rose varieties that are winter-hardy in one section of the country but suffer severe damage at a location much farther south where the temperature is higher. Generally, the southern location is one where the temperature is subject to considerable fluctuation throughout the winter. A fluctuating temperature in winter is far harder on roses than a constantly low temperature.

In sections where winter conditions usually result in injury to the canes, it is necessary to provide some form of winter protection. For hybrid teas, polyanthas, and hybrid polyanthas, the best method is to mound up soil around the base

of the plant and to stake and tie all canes that might be blown about, thereby loosening the root system. Pile the soil at least 8 to 10 inches high. In small rose beds it is better to bring in soil from another part of the garden rather than risk the danger of exposing the roots. This protection should be given right after the first heavy killing frost and while the soil can still be easily worked. Inspect the plants frequently to be sure the soil is not washed away before the ground freezes. Protection by mounding is usually effective in areas where the temperature does not drop below zero.

In regions where the temperature regularly goes below zero, protection in addition to mounding with soil is required. This may be provided by hay, straw, or strawy manure. These materials should be piled about the plants, and may be held in place by throwing on a few shovelfuls of soil.

Tree roses and climbers are more difficult to protect in winter than hybrid teas and the bush types. In addition, tree roses are especially susceptible to winter injury and

must be protected when the temperature is from 10° to 15° below zero. These plants should be pulled over on one side and covered with soil. This is done by digging under the roots on one side until the plants can be pulled over without completely breaking all root connections with the soil. The entire plant is then covered with several inches of soil. An effective method in areas where the temperature does not often drop to zero is to wrap the head of the plant in straw and cover with burlap.

Climbing roses need protection in areas where the temperature drops below zero. The canes should be laid on the ground, held down with wire pins or notched stakes, and covered with several inches of soil. Even where winter temperatures are mild, protection from winter sun and drying winds is important, especially when the roses are growing in an exposed position.

Soil mounds should be removed as soon as danger of severe frost has passed. The soil must be removed carefully to avoid breaking off any shoots that may have started to grow beneath the soil mound.

Propagation

Most amateur rose growers will find it more satisfactory and less expensive to buy their plants from a responsible nurseryman than to propagate them. A knowledge of how the work is done, however, may be useful in special cases, as, for example, in perpetuating favorite old varieties and others not readily available or in testing promising seedlings. Also, many persons find the work itself interesting and a source of pleasure. Patented varieties should not be propagated without permission of the patent owner.

Propagation by Budding

Hybrid teas and other similar classes of roses that bloom throughout the summer and are intended for garden planting are commonly propagated in either of two ways: (1) The cuttings may be rooted to develop plants called "own root" roses; or (2) the desired varieties may be budded on to species that have been found especially well suited to form root systems. Species used in the latter manner are termed "stocks."

Budding is really a form of graft-

ing whereby a single leaf bud instead of a section of the stem is taken to develop a new plant. Budded hybrid tea roses are usually preferred to those on their own roots for two reasons: (1) Larger plants can be produced in two seasons by budding than from cuttings; and (2) when well established on the best stocks budded plants usually continue in more robust growth and produce more flowers than own-root plants of similar age under the same conditions. These two advantages more than offset the greater cost of production.

For field budding, 1-year-old plants are used for understocks in most places, whether seedlings or cuttings. In the North, multiflora seedlings are commonly used. In the South, however, unrooted multiflora cuttings often are planted early in spring and budded the same season. The stocks are planted 8 to 10 inches apart in rows as early in the spring as the soil can be put in good condition. When seedlings are to be budded, they should be planted with the main root an inch or two above the ground level so that the bud can be inserted on the yellow root tissue rather than on the leaf-bearing portion of the stem. This low budding reduces sprouting from the understock after the plants are grown. A ridge of soil is brought up to the row to protect the stems from drying until they have started growth.

A very sharp knife is needed for budding—whether it be a pocket knife or a budding knife. Budding knives are made with a projection near the point on the back of the blade or with a flattened extension on the handle to use in lifting the bark. Such knives are needed if very much budding is to be done. Good work, however, can be accomplished with a pocket knife if it is sharpened to a keen edge.

Budding can be done from about June 1 to September 15. The most favorable time depends on the condition of the stocks and of the plants from which the buds are taken. Stocks must be in a sufficiently active state of growth that the bark will separate easily from the wood. This insures a close fit of the inserted bud against the wood that is exposed when the stock is opened. It is useless to bud if the bark on the stock has a stringy, dry appearance and adheres to the wood when an attempt is made to raise it.

The best size of stocks for budding have a diameter of about $\frac{3}{16}$ to $\frac{3}{8}$ of an inch at the point where the bud is to be placed. When the stocks are larger the bark is correspondingly thicker. This additional thickness, together with the greater diameter, makes it difficult to bandage the bud firmly in place. Stocks smaller than $\frac{3}{16}$ of an inch in diameter can be used successfully, but the buds are not so easily inserted as in those ranging within the limits of $\frac{3}{16}$ to $\frac{3}{8}$ of an inch.

The buds to be inserted are branch buds from stems carrying flowers at about the full-bloom stage. Such stems are commonly called bud sticks. The three or four buds below the flower (omitting the small bud next to the flower) are usually preferred to those farther down the stem because they are larger. The buds should be plump but dormant. A further indicator of the proper stage of bud development is the condition of the thorns. If the thorns separate readily without breaking the bark, the buds, at least part of them, are commonly usable. The buds of some varieties, however, break into growth before the thorns shed easily. In such instances, take the buds while the thorns are still immature, and remove the thorns by cutting rather than by breaking. Avoid injuring the bark while re-

moving the thorns from the bud sticks. Next, cut off the leaves and leave only about $\frac{1}{4}$ of an inch of the petiole, which serves to protect the bud and assist in pushing it into place.

The bud sticks can be preserved in good condition for 2 or 3 days if kept moist and cool. However, the buds can be injured beyond recovery in a short time if they are exposed to heat or dry air. Wet burlap, muslin, and water-absorbing paper are suitable materials in which to pack them temporarily. Some budders carry the bud sticks in a pail of water, taking out a stick at a time as used. The refresher pans of household electric refrigerators are ideal for keeping budwood in good condition.

The stocks are prepared for budding by first drawing back any soil that may interfere with working around the stem. Next, prune canes that are so low as to be in the way. Then rub the stem free from adhering soil where the bud is to be placed. The side of the stock facing north is a slightly advantageous position for the bud, other things being equal, because it is shaded during the hottest part of the day. A matrix resembling a T in outline is formed by making two cuts through the bark with a knife. The first cut is vertical and about 1 inch long. Then a second cut is cross-cut near the upper end of the vertical cut to form the T. The bark is then lifted along both sides of the vertical cut by using the spur on the back of the budding knife or the spatula-shaped reverse end of its handle.

The bud is pared from the stem to include a shield-shaped piece of bark about $\frac{3}{4}$ of an inch long. Start the cut about $\frac{1}{4}$ of an inch down the stem from a bud, cutting upward, and run it under the bud deep enough to take only a thin

sliver of wood. Some budders remove this sliver to obtain more contact between the bud and the inner bark when the bud is put into the stock. Others disregard the slivers of wood, but they are careful to include only a very small portion of it and to make the cut surface as nearly flat as possible so that the sliver will be pressed close against the exposed wood surface of the stock.

A definite procedure should be followed in inserting the bud into the T-opening. Start the bud into place while it lies on the knife blade. Then push it down with the thumb so that its cut surface is flat against the wood at all points. Be careful not to touch the cut surface of the bud. Also avoid folding the edges or tearing the flap of bark on the stock. The bud must be held firmly in place by a bandage made of twine, a strip of elastic rubber, raffia, or other material durable enough to last 3 or 4 weeks. Wrap the bandage around three or four times below the inserted bud as well as above it, leaving exposed only the bud or "eye." Keep the bark of the stock in place over the edges of the inserted bud while tying the bandage.

After 2 or 3 weeks the bandages should be examined, and, if the stocks have grown in circumference enough to cause constriction by the bandage, it should be cut on the side opposite the bud. It is not necessary to remove the cut bandage; it will fall away gradually of its own accord. When the bandages are cut, examine the buds and rebud any that have failed.

Ordinarily, buds remain dormant until the following spring, although occasionally one may start to grow within a few weeks after budding. In early spring when the inserted buds begin to grow, the stock tops should be cut off. Use a sharp

shears or fine-toothed saw and make each cut $\frac{1}{2}$ inch above the bud. During the first few weeks of active growth remove any sprouts arising above or below the inserted bud. When the plants are 5 or 6 inches high, pinch out the growing point to encourage branching and to keep the plant low until the soft stem begins to harden. This precaution lessens the danger of the stem being broken off by the wind at the point of union.

Propagation by Cuttings

Nearly all varieties of roses can be started from cuttings, although some root much more readily than others. The several classes of strong-growing pillar, climber, polyantha, and hybrid perpetuals in particular are often increased by this means, and the resulting plants are usually satisfactory. Hybrid teas and other similar classes of ever-blooming roses, too, are very often started from cuttings. Ordinarily, however, they develop more slowly from cuttings than when propagated by budding onto more robust types, either while the plants are dormant or while in a state of active growth.

Hardwood or Dormant Cuttings

Hardwood or dormant cuttings are planted outdoors in the open ground in sections where the winters are mild. Such cuttings should be supplied with water during a long, cool spring season either by rainfall or by irrigation. Details of procedure vary in different localities, but the process for roses is similar to the general one followed in starting many other shrubs and trees from hardwood cuttings. The wood is taken during early winter while the plants are dormant but before it is severely frozen. Medium-sized canes of the preceding season's growth are selected. Avoid those that are extra large and any that ap-

pear immature. Until used the canes must be stored in a manner to keep them fresh. Often they can be buried in moist sandy soil. Where damage from freezing does not occur the canes can be taken in mid-winter. This wood is cut into lengths of 6 to 8 inches at any convenient time during winter. The cuttings are then tied into bundles of convenient size. Be careful to keep them all lying one way to insure planting with the buds pointing upward.

Softwood Cuttings

Home gardeners not interested in quantity production often wish to propagate a few rose plants of favorite varieties by softwood cuttings. One method often used is as follows: In midsummer, after the flowers have fallen, make 6- to 8-inch cuttings from the stems. Take off all leaves except one or two at the top. Then plant the cuttings firmly with half their length below ground. After watering, invert a glass fruit jar over them. Another way to make softwood cuttings is to take wood that has ripened well in autumn, remove all leaves, cut it into 8- or 10-inch lengths, and plant them in a well-protected sunny place, with only the top bud above ground. When freezing weather approaches, a mulch of litter several inches deep is put over them to keep the ground from freezing.

Propagation From Seed

Reproduction of roses by seed is of primary importance to the breeder in his search for new roses with superior qualities. Seed is the principal source of new varieties, although sometimes new ones originate as bud variants or "sports."

Seedlings of the many garden varieties are of little value to the gardener who wishes his young plants to be like their seed parents, as such seedlings always differ from their



Figure 8.—Preparing a rose bud for cross-pollination: Left, cutting petals at base; center, cutting tip of bud; right, emasculated flower with pollen about to be applied with a camel's hair brush.

parents in important respects and are usually inferior. In other words, the named varieties do not "come true" from seed. Nevertheless, some gardeners are becoming interested in trying to develop new varieties by means of hybridization. When two rose varieties are cross-pollinated, the method commonly used is shown in figure 8. Small curved scissors are excellent for cutting away the petals, and the pollen-bearing anthers before they shed their pollen. The emasculated flower is then covered with a paper bag to keep unwanted pollen from reaching the stigma. In a day or two the stigma is covered with a sticky substance called stigmatic fluid. It is now receptive. Remove the bag, and place the pollen collected from the desired parent plant on the stigma with a camel's hair brush. The paper bag is replaced, and, if the cross-pollination is successful, a seed pod soon starts to form. The information concerning the cross-

pollination is recorded on a label that is fastened to the stem below the pollinated flower. All hybridizers place the name of the seed parent first in recording a cross. Thus if *Crimson Glory* is crossed with *Charlotte Armstrong*, the label would read: "*Crimson Glory* × *Charlotte Armstrong*." The date the cross was made is also recorded. The various stages of change from flower buds to large seed pods are shown in figure 9.

True botanical species reproduce themselves within close limits of variability. Hence, the species of roses desirable for use with other shrubs in ornamental plantings may often be grown from seed to good advantage, especially if facilities for handling cuttings, grafts, or other vegetative means of propagation are not convenient. Seedlings are grown in very large numbers, also, to form the root systems or stocks for budded roses.

When the rose seed pods (hips)

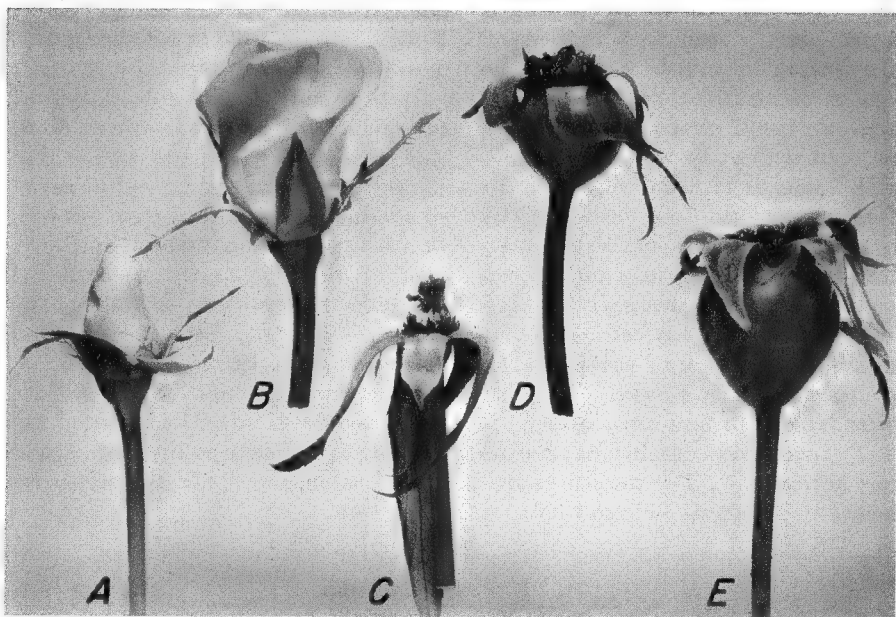


Figure 9.—A and B, Flower buds ready for emasculation. The larger bud may have already shed some pollen and if so should be discarded. C, An emasculated flower. D and E, Two stages of development of seed pods (hips). Note developing seeds protruding from the top of D.

appear mature they are collected and the seed separated. If only a small quantity is to be grown the seed can be taken out by hand. The seed of most species of roses is not in condition to germinate at once when removed from the plant at apparent maturity. They must remain for a period in a moist state at a cool temperature to complete the internal development known as after-ripening. A temperature of about 41° F. is the most favorable for after-ripening of the seed of many species, although some germinate sooner if kept just above the freezing point. Storage near the coils of a household electric refrigerator will give approximately the correct temperature. The seed is usually "stratified" to keep it moist. Stratification is done by packing the seed in a box in alternate layers of about 1/2 inch of seed and 1 inch of sand or granulated peat. Peat is better than sand, probably because of its greater ability to hold moisture. The purpose of stratifying is to provide the seed with more even distribution of moisture, lessen the danger of heating, and reduce attacks of fungi that might damage the seed if kept in a mass.

The length of time required for after-ripening the seed varies greatly with the various species of roses. *Rosa multiflora* requires only a few weeks and germinates early the following spring. *Rosa canina*, *R. rugosa*, *R. hugonis*, and several other species are much slower. They require from 4 to 6 months under the most favorable conditions before they germinate. Temperatures that fluctuate between 32° and 50° F.

are effective for after-ripening if the average is about 41°. A longer period may be necessary if the temperature is not kept within narrow fluctuations. Under natural conditions seeds of these species often lie dormant until the second spring after planting.

Crosses of varieties may germinate irregularly, some seed sprouting within a few weeks and other seed starting from time to time over a period of several months. Where it is desired in such crosses to get all the seedlings possible as well as species that after-ripen slowly, artificially controlled temperature is valuable. A household electric refrigerator can often be used effectively to provide a favorable temperature to hasten after-ripening of small lots. The seed should be mixed with sand or peat and kept moist. When the seed begins to germinate it must be planted without delay. Avoid deep plantings. About 1/4 inch of sand or soil over the seed is enough when started under glass. Keep the soil moist at all times, but avoid overwatering.

If the seedlings are 4 to 6 inches tall, they may be left in the ground the first winter in areas where the temperature does not go below zero. A mound of soil, however, should be formed around them. Seedlings smaller than 4 inches are usually not able to stand very low temperatures. They should be dug and stored in a moist atmosphere at a temperature of about 35° to 38° F. Such seedlings may be planted in the spring as soon as the last severe frost has occurred and the soil is in condition.

Diseases of Roses

There are many diseases of roses. Fortunately, most of them are of minor importance—or appear chiefly

on plants that have been weakened by unfavorable cultural conditions, unfavorable climatic factors, insects,

or some other disease. It is true, however, that black spot, powdery mildew, rust, crown gall, and the cankers may be considered to be of major importance. Furthermore, control measures commonly recommended for black spot or powdery mildew are effective against rust, and frequently are indirectly effective in controlling the canker diseases.

Black Spot

So widespread and prevalent is black spot that it hardly requires description. The name itself characterizes the principal symptom. The circular black spots have irregular radiating margins and are frequently surrounded by a yellow halo, as shown in figure 10. The spots may be as small as 1/16 inch in diameter or they may nearly equal the width of the leaves. Infected leaves characteristically turn yellow and fall prematurely. When the attack is severe the plants may be almost completely defoliated by mid-summer. Growing replacements for the fallen leaves seriously reduces the vitality of the rose plant. Furthermore, these new leaves and shoots are soft and immature at the beginning of winter. Thus black-spot-infected plants are much more susceptible to winter injury than are healthy plants. The succulent shoots of some varieties are also susceptible to black spot infection, and the fungus may survive the winter in these infected shoots. Plants infected with black spot or otherwise weakened are predisposed to dieback and to stem cankers.

Black spot is indirectly responsible for a pale flower color often occurring in many varieties. Diseased leaves and defoliated plants manufacture less of the sugars that are important in intensifying flower color.

Black spot is spread by splashing

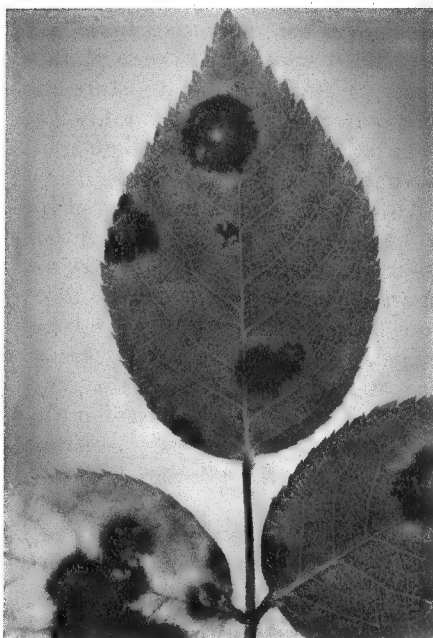


Figure 10.—Black spot disease on rose leaflets. As these spots increase in size they often run together and cover the entire leaflet. Severely infected leaves fall from the plant. When black spot is unchecked it may almost defoliate the rose plant.

water, and infection takes place only when water remains on the leaves for several hours. Consequently, black spot is most serious in areas of high rainfall and is least serious in arid regions. Even in dry regions overhead irrigation may permit the development and spread of this disease if viable spores are present. Because black spot is spread by splashing water, greenhouse operators no longer syringe their roses, and, if they spray for insect control, they do this during the morning of a bright day so the foliage will dry rapidly. Aerosol bombs are now generally used in greenhouses to control insects and, as a consequence, black spot of roses grown under glass has declined from the rank of the No. 1 disease enemy to insignificance.

Free water must be present on

rose leaves for at least 6 hours before black spot infection will take place. With favorable moisture and temperature conditions, it takes 7 to 10 days for the typical radiate spots to appear.

All classes of roses are susceptible to black spot in varying degrees. Roses of Austrian Briar ancestry are especially susceptible, whereas those from Wichuraiana and Rugosa types are generally resistant. Polyanthas, teas, and hybrid teas are all susceptible. The Welch variety of multiflora understock is highly resistant, if not immune.

Control

Control measures effective against black spot are also effective against rust and mildew. Preventive measures should start when the bushes are pruned in the early spring. The bushes should be stripped of all diseased leaves and the leaves on the ground should be raked and burned to eliminate sources of overwintering spores. Begin spraying or dusting when leaves are half-grown. Spray or dust at weekly intervals during the spring or other rainy periods. A good grade of dusting sulfur, a mixture of sulfur-lead arsenate (Massey dust), a sulfur-copper dust (90:10), or a sulfur-ferbam dust are all very effective. Ferbam is very effective for rust. Copper sprays are effective against black spot but not against mildew. Copper may cause foliage injury at temperatures below 65° F. Too frequent use of sulfur during dry, hot weather may result in burning the foliage.

Powdery Mildew

Powdery mildew is characterized by white powdery masses of spores on young leaves, shoots, and buds (fig. 11). These powdery masses occur as blisterlike areas on young leaves. On the older leaves they appear as grayish-white patches.

On young shoots mildew may cause swellings or marked distortion. In severe attacks the foliage is stunted and the leaves and shoots are badly distorted. Unopened buds may be covered with the powdery masses of white spores. Late in the season the patches of white mold take on a dirty-gray color, and minute spherical black bodies may be seen embedded in them. These black bodies are the resting spore stage of the fungus, which enables it to survive the winter on persistent or fallen leaves and in infected bud scales and flower stems.

In contrast to black spot, powdery mildew is not spread by splashing water. The spores are wind-borne. In fact, excessive rainfall or syringing retards the development of powdery mildew. While the mycelium or vegetative body of the black spot fungus grows within the leaf, the mycelium of the powdery mildew fungus grows almost entirely on the outside of the leaf and therefore may be injured rather than spread by splashing water. Temperatures higher than 85° F. are unfavorable for mildew development.

This disease can be severe in areas of low rainfall, because the humidity at the surface of young leaves is high enough to permit good germination of the disease spores even though atmospheric humidity is low. Under favorable temperature conditions only a few days need elapse after infection before large numbers of spores are ready to be blown by gentle air currents to new leaves where many new infections will be established.

Hybrid teas, climbers, and rambler roses are usually considered highly susceptible to powdery mildew, whereas Wichuraiana roses are regarded as very resistant.

Control

See "Control" under Black Spot, p. 26.

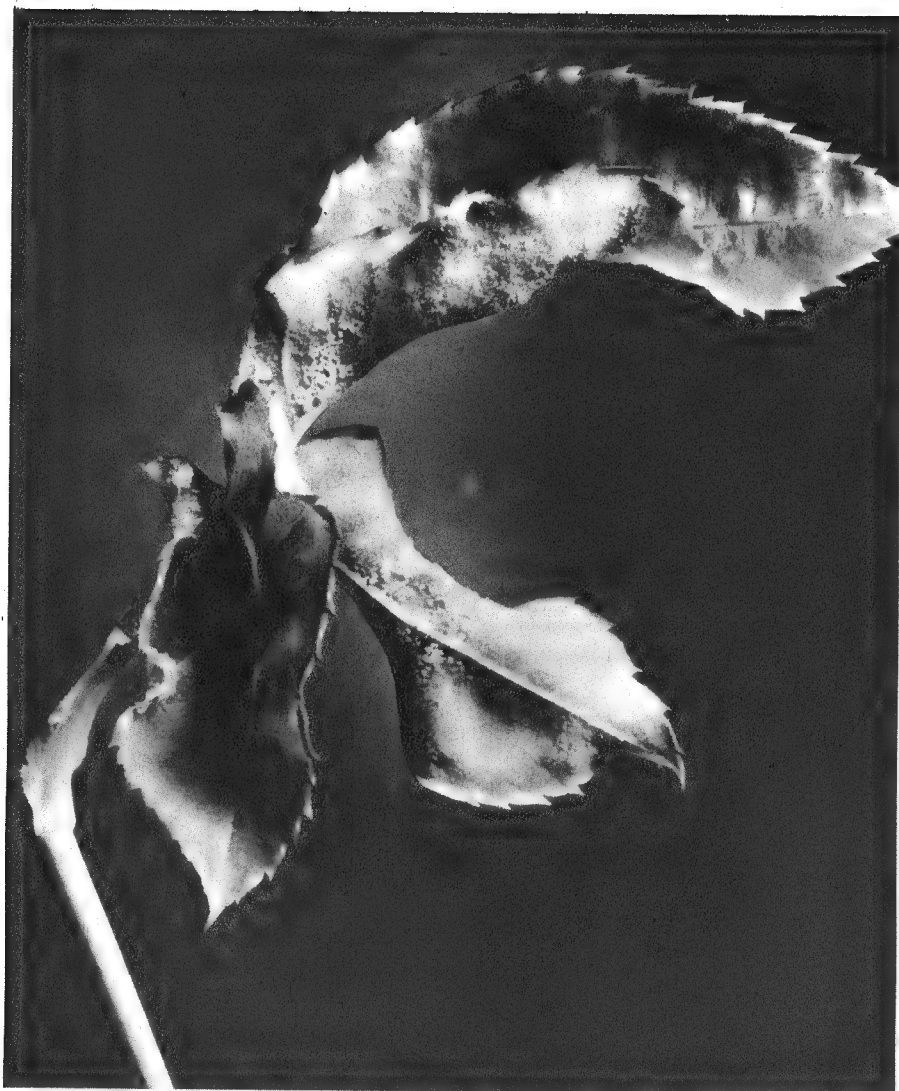


Figure 11 —Powdery mildew on rose leaflets. Note the twisted leaves. When severe, this disease may cause premature falling of the leaves.

Rust

The rust of roses is very destructive wherever it is found. It is favored by a cool, humid summer climate followed by mild winters. The Pacific Coast is the only large climatic region where these favorable temperature and moisture conditions regularly prevail.

The most characteristic symptom of this disease is the appearance of small orange-colored pustules. In

early spring very small, inconspicuous orange or yellow masses may appear on either surface of the leaves. Later, the typical orange-colored pustules appear on the lower surface. Spores from these pustules may be blown to other leaves where they start new infections. In late summer or early fall the character of these pustules changes and black ones appear. The pustules that overwinter within the leaf tissue

after the leaves have fallen produce spores that cause the spring infection. Young green stems may also be infected, but the most serious injury is the defoliation that results from a severe attack.

Most hybrid tea roses and many of the species roses are susceptible to rust. Those that appear to be resistant are *Rosa gallica*, *R. palustris*, *R. rudijscula*, *R. arkansana*, and Ragged Robin.

Control

See "Control" under Black Spot, p. 26.

Canker Diseases

There are several canker diseases of roses—stem canker, crown canker, brown canker, and brand canker. In general cankers occur only in plants that have suffered wounds or



Figure 12.—Rose cane infected with canker. Such a cane should be cut and destroyed. Cut the stem several inches below the canker.

in plants that have been weakened by causes such as excessive defoliation by black spot, winter injury, or poor nutrition. Rose cane infected with canker is shown in figure 12.

Cankers first appear as small reddish spots on the stems. They grow in size and eventually encircle the stem. As they increase in size they become darker in color, changing from light to dark brown, and small fruiting bodies of the fungus appear within the discolored area. The bark in the infected area dries out and splits. If the cane is girdled by the canker the leaves above the canker wilt and this portion of the cane will die. If the canker is allowed to remain the disease may spread slowly down the cane and eventually kill the lower branches.

Control

Control of the canker diseases lies mainly in prevention. If the plants are maintained in a healthy condition, if wounds are avoided, if proper winter protection is provided, and if care is taken when pruning, the cankers, with the exception of brown canker, should be of little concern.

The danger of canker infections can be reduced when pruning if clean cuts are made near a bud. Such cuts heal quickly. Ragged cuts and cuts made too far from a bud heal slowly and are vulnerable to attack by canker fungi. All cankered canes should be pruned out whenever detected. Special care should be taken in the late spring, just before growth begins, to detect and remove cankered canes. Disinfect shears and other cutting tools after use on a cankerous plant.

Crown Gall

Crown gall is a bacterial disease that affects many plants, including roses. The galls characteristic of the disease usually occur at the

ground level, but may sometimes be found on the upper portion of the stem, as shown in figure 13, or on the roots. They begin as small swellings which slowly increase in size. Galls may become quite large before they produce any noticeable effect on the growth of the plant. Infected plants become stunted and eventually may be killed.

The organism causing the disease does not kill the plant tissue; it stimulates abnormal growth of the plant tissue that results in the formation of galls.

Control

Control of the disease is largely a matter of prevention. Buy plants free of crown gall and plant them in soil that has been free of crown-gall-infected plants for at least 2 years.

A plant once infected with crown gall cannot be cured. Infected plants should be removed and burned.

Virus Diseases

There are a number of virus diseases that attack roses. So far as is known, none of these diseases that occur in the United States are transmitted by insects. Characteristically, virus diseases transmitted by insects spread rapidly. In this country, viruses are carried in cuttings and scions taken from infected plants, and the spread of the disease seems to occur only during propagation.

The symptoms of the rose viruses vary widely, as shown in figure 14. The leaves of plants infected with mosaic have small, angular, chlorotic spots, which show a characteristic lack of color. They are most numerous at or near the midribs of the leaflets. Ring, oak-leaf, and watermark patterns may be observed at times. There may be no reduction in vigor or the plant may

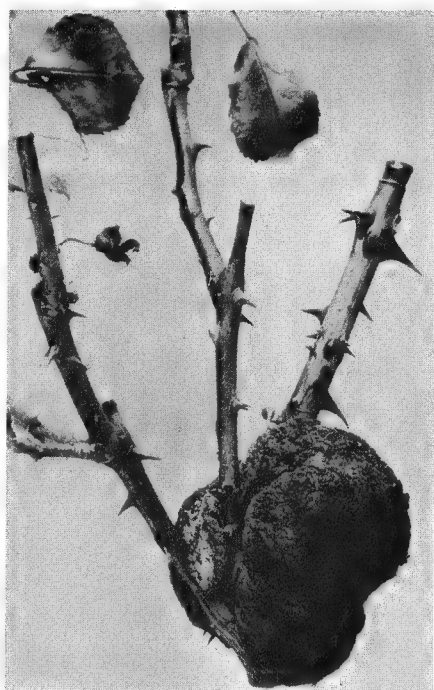


Figure 13.—Typical crown galls on roses. Infected plants cannot be cured.

be slightly to severely dwarfed.

The "yellow mosaics" differ from the above mosaics mainly in color. The chlorotic areas generally are a brighter and lighter yellow, and very conspicuous (fig. 14, D). A third virus disease, known as rose streak, produces brown rings, brown or yellowish vein banding, and brownish or greenish ring markings in canes of climbers and others.

Several types of viruslike patterns occur in rose foliage, such as lime-induced chlorosis (caused by an excess of lime), in which the leaf blade becomes uniformly yellow. The bright yellow or white variegations appear to be genetic in origin.

The development and maintenance of disease-free stock plants to supply cuttings for understock and the critical selection of budwood by the nurserymen should result in the production of virus-free roses. There is no evidence that the viruses of roses are transmitted by handling.

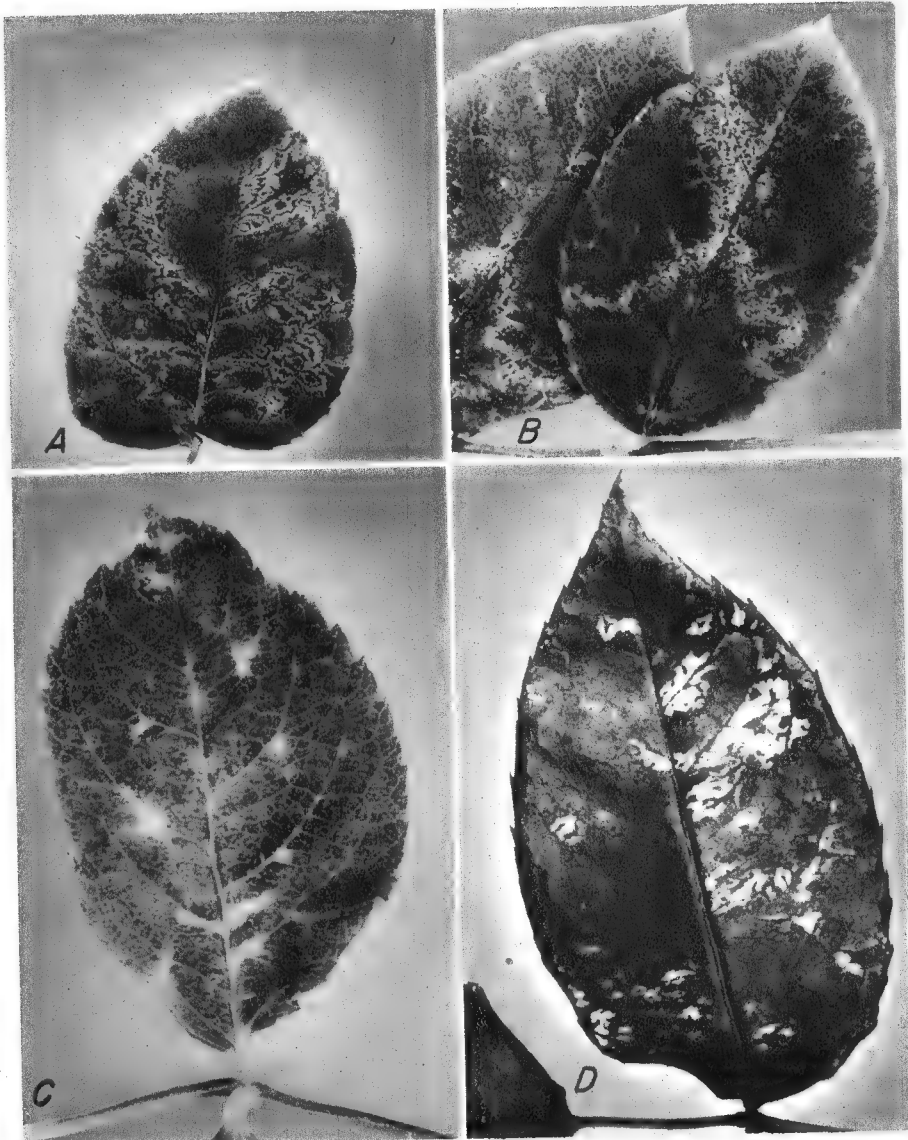


Figure 14.—Rose mosaic, a virus disease of roses, varies in appearance on different varieties: A, On the variety Butterfly, B, on the variety Duchess of Wellington, C, on the variety Templar, and D, on the variety Briarcliff.

Insects Attacking Roses

Roses are attacked by a large number of insects. The most common ones are the Japanese beetle, rose chafer, rose leaf beetle, rose leafhopper, flower thrips, rose aphid, rose scale, rose midge, leaf-cutter

bees, two-spotted spider mite, rose stem sawfly, raspberry cane borer, rose stem girdler, mossy rose gall, and rose root gall.

The numerous remedies used in the past to control insects have

varied in their effectiveness. Since DDT and other new materials have become available, more effective controls are possible.

When preparing blooms for exhibit, it may be desirable to protect prized plants and flowers from insect attacks by covering them with cheesecloth or other coarsely woven cloth on a light framework.

Insecticides are Poisons

Special care should be exercised in handling, mixing, and applying insecticides, not to inhale the dust, fumes, or vapors. If necessary, use

a respirator that will protect the entire face. After working with insecticides, thoroughly wash the hands or any exposed parts of the body. Label plainly the containers in which these materials are kept or stored, and place them out of reach of irresponsible persons or children.

Japanese Beetles

Japanese beetles attack rose flowers and foliage during July and August (fig. 15). In areas of moderate infestation the plants can be protected by frequent applications of 5 percent DDT dust. In heavily

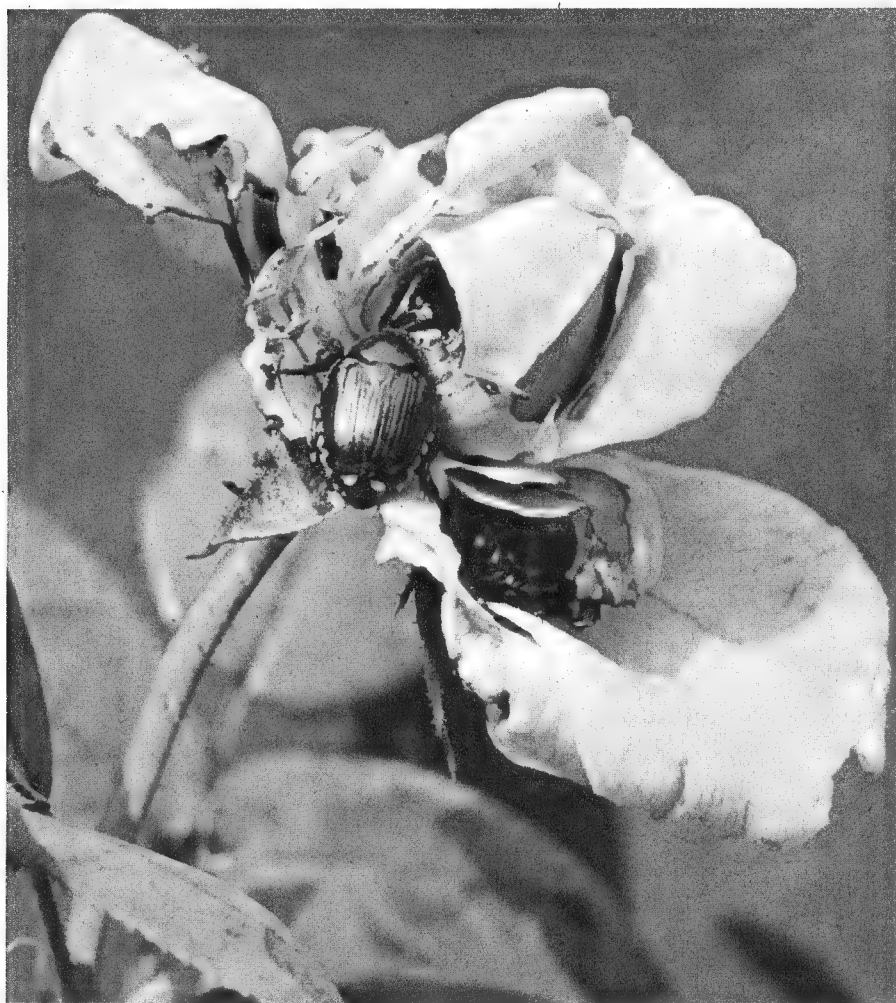


Figure 15.—Japanese beetles feeding on a rosebud.



Figure 16.—Typical rose leaf beetle. ▲



Figure 17.—Rose slugs feeding on rose leaflet. ➔

Figure 18.—Rose leaf hoppers on under side of a rose leaf. ▼



infested areas the use of cheesecloth cages or bags may be necessary.

Rose Chafer

Yellowish-brown beetles, known as rose chafers, are often abundant during June and early in July, especially in areas of light sandy soil. They are about $\frac{1}{2}$ inch long and have long spiny legs. These beetles develop on roots of grasses and weeds and appear suddenly on rose petals, where they feed and may destroy the entire flower. Dusting with 5 percent DDT is effective.

Rose Leaf Beetle

The rose leaf beetle (fig. 16) is a small, oval, metallic-green beetle, which feeds in the buds and on the flowers of roses, often riddling them with holes. The insects are most numerous in suburban gardens near uncultivated fields, where the larvae feed on roots in the soil. The adults may be killed by dusting with 5 percent DDT.

Rose Slugs

Three species of sawflies, small wasplike insects, lay their eggs in rose foliage, and the dark-green larvae, known as slugs, feed on the leaves. Their injury is recognized by the skeletonized effect on the leaves. Figure 17 shows the upper surface of a leaf destroyed by sawflies and also irregular areas where the leaf tissue is entirely eaten away. Rose slugs are readily killed by dusts containing 5 percent DDT. The treatments must be applied promptly, because the insects appear suddenly and do their damage quickly.

Rose Leafhopper

The rose leafhopper, a tiny greenish-yellow jumping insect, shown in figure 18, is frequently found on the under side of rose

leaves. The insects suck out the contents of the leaf cells causing a stippling of the leaves that resembles injury by spider mites. Dusting the under side of the foliage with 5 percent DDT will destroy the young nymphs and many of the adults.

Thrips

For several weeks each summer the petals of garden roses, especially white varieties, may become brown. This injury is caused by the flower thrips and related species that enter the opening flowers. The tiny yellow or brown thrips can be seen if an infested flower is shaken over a sheet of white paper. A typical thrips, greatly enlarged, is shown in figure 19. The thrips breed on grasses and weeds in the spring and they fly to roses and other flowers. No fully satisfactory remedy is available because of the daily influx of thrips to the rapidly expanding flowers, which cannot be kept adequately covered with an insecticide. Applications of 5-percent DDT dust or of 1-percent lindane to flowers and buds every 2 or 3 days will destroy many thrips as they alight on the flowers.

Aphids

Several species of aphids, but particularly the rose aphid, occur on stems, leaves, and buds of garden roses. By sucking the plant juices

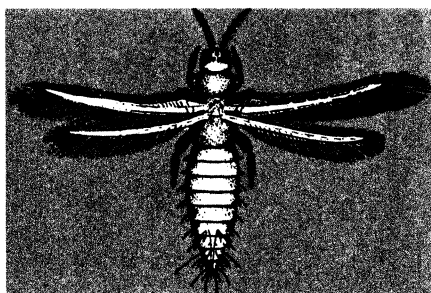


Figure 19.—A typical flower thrips greatly enlarged. These tiny insects feed on opening flowers, causing them to turn brown.



Figure 20.—Aphids feeding on rosebuds.



Figure 21.—Rose cane severely infested with rose scale.



Figure 22.—Typical damage to roses caused by the rose midge.

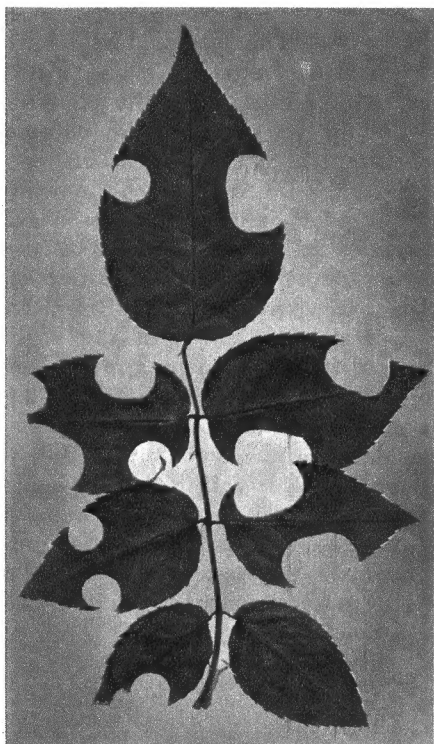


Figure 23.—Circular pieces cut out of rose leaflets by leaf-cutter bees.

they stunt its growth. They often occur in large numbers on rosebuds (fig. 20). The insects also secrete a sticky honeydew, which accumulates on the foliage. A spray containing $1\frac{1}{2}$ teaspoonfuls of nicotine sulfate (40 percent) in 1 gallon of soapy water will destroy an infestation. A spray containing malathion, as used for spider mites, is also effective.

Rose Scale

Old rose stems sometimes become encrusted with white insects known as rose scale (fig. 21). The insects suck the sap from the plants and consequently regular use of 5-percent DDT dust during the summer will reduce the number of young rose scale crawlers. If the scales persist until fall, the stems most severely affected can be pruned out, and the remaining ones sprayed thoroughly

during the dormant season with a white-oil emulsion containing $\frac{1}{2}$ cup of the concentrate per gallon of water.

Rose Midge

The rose midge is sometimes a serious pest of greenhouse and garden roses. This tiny yellowish fly lays its eggs in the growing tips of the rose stems. The maggots that hatch from the eggs destroy the tender tissue, killing the tips and deforming the buds (fig. 22). The infested tips should be cut and burned to destroy the maggots. To prevent new infestations the egg-laying adults emerging from the soil can be destroyed by dusting the foliage with 5-percent DDT or 1-percent lindane. Applications should be repeated every 5 to 7 days for at least 1 month.

Leaf-Cutter Bees

Leaf-cutter bees cut circular pieces from rose leaves and other plants (fig. 23) and store them as food for their young in burrows dug in the pith of rose stems. The tunneled stems usually die back for several inches. A carpet tack pushed into the end of the cut stems at pruning time will prevent the bees from entering and tunneling the stems. Tree-wound paint can also be applied to the cut stems.

Spider Mites

The two-spotted spider mite sucks the juices from the leaves, which soon become stippled. As the injury progresses the leaves turn brown, curl, and drop off. When the mites are abundant they spin a web over the leaf surface. Infested plants are unthrifty.

These spider mites are usually greenish with two brown spots, although some are dark red. They are almost too small to be seen without a magnifying glass. A typical

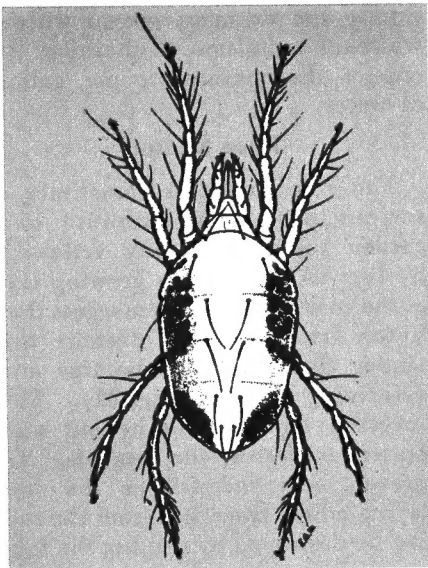


Figure 24.—A typical spider mite greatly enlarged.

mite greatly enlarged is shown in figure 24. The spherical eggs have a glistening surface. The mites overwinter as eggs on the plant or as adults in trash. They become abundant in hot, dry weather.

When DDT is used to control other pests it destroys the insect enemies of spider mites and the latter tend to become more numerous. To control spider mites clean up trash and leaves in the early spring, make frequent applications of dusting sulfur or dusts containing 1 percent of rotenone to the leaves, or syringe them with water. When these methods fail, use a miticide such as Aramite or malathion in a dust or spray and make two applications—a week apart—at the dilution recommended on the container.

Rose Stem Borers

The stems of garden roses are occasionally infested with one of

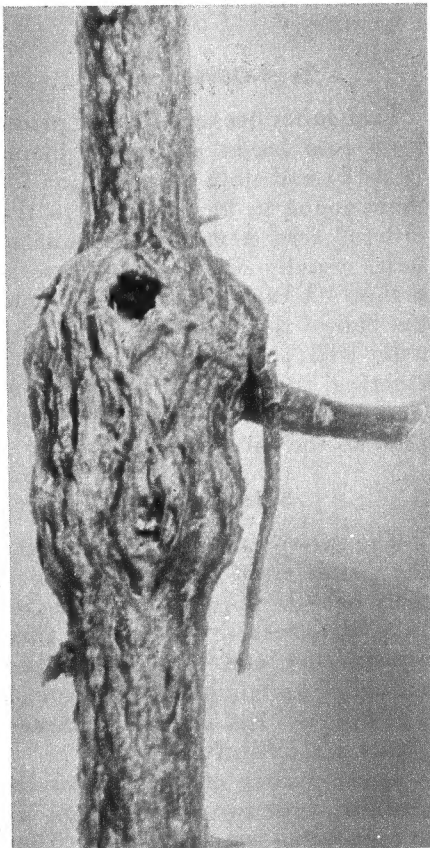


Figure 25.—Damage to rose canes caused by stem girdlers.

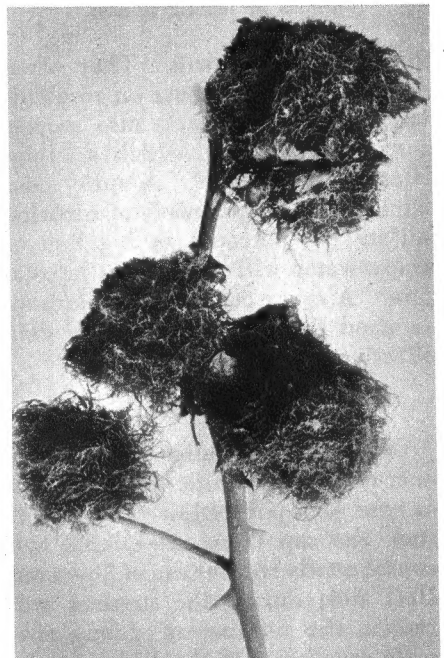


Figure 26.—Fibrous mossy galls on the stems of roses resulting from infestations by wasplike insects that lay their eggs in the rose stems.

several kinds of borers, including the rose stem sawfly, the raspberry cane borer, and the rose stem girdler. These stems usually die back, and, as shown in figure 25, those infested with the stem girdler develop a marked swelling at the point of injury. Infested stems should be cut and burned.

Applications of 5-percent DDT dust at weekly intervals during June and July when the adult beetles are present will also help to prevent reinfestation.

Rose Galls

Several species of wasplike insects lay their eggs in stems of roses and

their larvae cause large swellings or galls. One species makes a gall resembling fibrous moss on the stem (fig. 26). Another causes a large wartlike gall near the ground surface. The infested stems should be pruned to remove the galls and should be burned promptly to destroy the larvae in the galls before they emerge. These galls, formed by insects, may be confused with the crown galls caused by bacteria and described on page 28. However, if the insect galls are cut open numerous larvae or the cells in which they develop will be visible. No insecticide known will control the insects that produce these galls.

General Recommendations for Disease and Insect Control

There are a few general measures that will be effective in solving most of the disease and insect problems of roses. These measures are rather simple. All that is needed is a good hand duster, a small sprayer, and a few insecticides and fungicides.

There are several good insecticide-fungicide combinations on the market. Effective compounds contain a mixture of the following ingredients in varying amounts: Sulfur, copper or ferbam, lindane, DDT or methoxychlor, and rotenone or Aramite. Compounds of these types are sold under several trade names. In some combinations certain organic fungicides replace the sulfur and other miticides replace the Aramite or rotenone. Nicotine sulfate and Aramite should be available for use as sprays to control any unusual infestations of aphids or mites. The nicotine is used at the rate of 1 teaspoonful per gallon of water to control aphids, and Aramite at the rate of 4 teaspoonfuls per gallon to control mites. Occasionally a white-oil emulsion will be needed to control scale.

The first requirement for successful disease and insect control is to begin with insect- and disease-free plants, particularly as regards crown gall and the virus diseases. During the growing season a weekly application of an insecticide-fungicide dust will keep most of the insects and diseases under control. If rust is a problem, the mixture containing ferbam should be used. When aphids appear it will be necessary to spray the plants with nicotine sulfate or malathion.

Dust applications containing a high content of sulfur should be discontinued during the hottest weather as they may burn the foliage. At this time, however, particularly if it is also dry, the spider mites build up rapidly and cause serious injury. Spray applications of Aramite or malathion will control the spider mites. Diseases do not spread during hot, dry weather. Weekly applications of the fungicide-insecticides are not always adequate for thrips control. It may be necessary to make two additional applications of a 5-percent DDT dust

3 days apart if the thrips build up rapidly.

Sanitation is very important in the rose garden. Old foliage and weeds should be cleaned up because they may become excellent sources of infestation by spider mites, thrips, and leafhoppers, as well as disease organisms. Rose chafers and rose leaf beetles breed in weedy areas or in other wasteland vegetation. It is essential to cut and burn infested

rose stems having borers, insect and bacterial galls, cankers, and rose midge-infested tips. When pruning out infested parts, make the cuts close to nodes or buds so that they will heal rapidly. In gardens where leaf-cutter bees enter the pith of cut stems, further injury can be prevented by pushing carpet tacks into the cut ends to close the wounds, or by painting the wounds with tree-wound paint.

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